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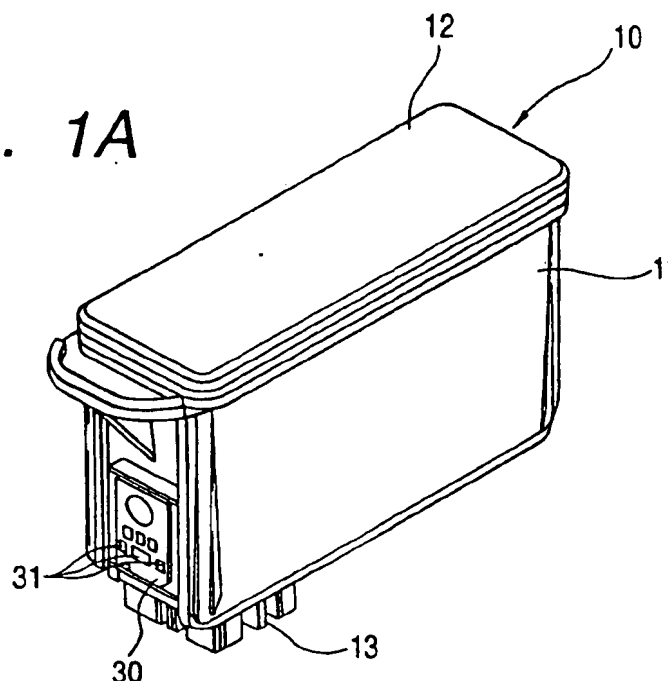
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## (54) Ink cartridge, ink-jet printing apparatus, and refilling device

(57) An ink cartridge for an ink jet type printing apparatus having a print head, the ink cartridge including: a container (11,21) having an ink chamber for containing ink therein; an ink supply port for ejecting the ink from the ink chamber to the print head; a memory device (32)

for storing data related to the ink or the ink cartridge, the memory device has an area in which the data is stored in a rewritable manner; and a contact device enabling the transmission of data between the memory device and an external device.

FIG. 1A



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a control device for controlling the operation of the above device.

Fig. 6 is a flow chart showing the operation of the above device.

Fig. 7 is a flowchart showing a main operation and a process of one ink cartridge in the cleaning process for the printing apparatus of the present invention.

Fig. 8 is a flowchart showing a process of the other ink cartridge in the cleaning process for the printing apparatus of the present invention;

Fig. 9 is a view showing one embodiment of an ink refilling device;

Fig. 10 is a flow chart showing the overall operation of the ink refilling device; and

Fig. 11 is a flow chart showing a charging process by the ink refilling device.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] The present invention will now be described in detail with reference to the drawings.

[0015] Fig. 1 show preferred embodiments of ink cartridges 10 and 20 suited for an ink-jet printing apparatus of the present invention. A container 11, 21 contains ink, and an upper side thereof is sealed by a lid 12, 22. A porous member is filled in the container 11, 21, and is impregnated with the ink.

[0016] An ink supply port 13, 23 is formed at the bottom surface of the container 11, 21, and when the container is mounted on a carriage 42, the ink supply port 13, 23 is hermetically engaged with ink supply needle (needles) 44, 45. A circuit board 30 is fixedly mounted on one side surface of the container 11, 21.

[0017] Contacts 31 for electrical contact with the printing apparatus are formed on that side of the circuit board 30, as shown in Figs. 2 (a) and 2(b), which serves as an outer surface when the circuit board 30 is mounted on the ink cartridge. Semiconductor memory device 32 is mounted in an accessible manner on that portion of the outer surface of the circuit board 30 which does not prevent the formation of the contacts 31.

[0018] Fixed data, such as the production date, the lifetime and the number of refilled times that can be made, are stored in the semiconductor memory device 32, and besides the following data and character series directly relating to those data can be stored in a rewritable manner in predetermined areas of this memory device 32:

- (1) The number of refilled times of the ink cartridge.
- (2) Maintenance conditions such as the condition of cleaning of the ink cartridge and the condition of exchange of parts at the time the ink cartridge is refilled.
- (3) Conditions of use such as the time of final use of the ink cartridge, the time of the final ink end, and

the environment of use of the ink cartridge.

In a case where the various kinds of data are stored by means of the character series data, the printing apparatus is designed to store data for interpreting the character series data. Accordingly, the memory capacity of the memory device 32 can be reduced remarkably.

[0019] Fig. 3 shows one example of a printing mechanism portion of the printing apparatus. The carriage 42 is connected to a drive motor 41 via a timing belt 40, and a holder 43 for holding the ink cartridge 10, containing black ink, and the ink cartridge 20, containing color inks, is formed at the upper side of the carriage 42, and a print head 46 for being supplied with the inks from the ink cartridges 10 and 20 through the ink needles 44 and 45 is provided at the lower surface of the carriage 42.

[0020] Fig. 4 shows the cross-sectional construction showing the condition of attachment of the ink cartridges to the carriage, using the black ink cartridge 10 as an example. When the ink cartridge 10 is properly connected to the ink supply needle 44, the contacts 31 of the circuit board 30 are connected to contacts 47 of the carriage 42, so that the ink cartridge 10 is connected to a control device 49 via a flexible cable 48, and the ink cartridge 10 is accessible from the control device 49.

[0021] Fig. 5 shows one example of a control device 49. Based on a signal from a host, head drive device 50 causes ink droplets to eject from the print head 46 in accordance with instruction signals from printing control device 51 and flushing control device 52 (for eliminating the clogging).

[0022] When the drive conditions and so on are stored in the memory device 32, the printing control device 51 reads the optimum drive conditions for the ink cartridge 10, 20 via access means 53, and effects the printing control. By doing so, even for a reproduced recycle product, the default drive conditions are determined such that the drive signal to be fed to the print head 46 can be adjusted so that the ink droplets can eject in the optimum amount, as described later.

[0023] Read-write control device 54 writes data, stored in data storage memory 55 onto the memory device 32 of the ink cartridges 10 and 20. The data storage memory 55 stores data related to the environment of use of the printing apparatus, detected by use environment detection means 56, the flushing operation by the flushing control device 52, and the cleaning operation by cleaning control device 57.

[0024] Next, the manner of use of the ink cartridges 10 and 20 of the above construction will be described with reference to a flow chart of Fig. 6.

[0025] When the ink cartridge 10, 20 is mounted onto the carriage 42, the printing control device 51 reads cartridge data stored in the semiconductor memory device 32 of the ink cartridge 10, 20 (Step B), and data indicative of the time of attachment is stored onto the semiconductor memory device 32 of the ink cartridge 10, 20 (Step C), and then it is judged from the number of re-

semiconductor memory device 32 of the second ink cartridge and an ink amount to be consumed by the cleaning operation (STEP L)

[0036] Under the operation as described above, when both the ink cartridges contain therein sufficient amount of ink, the cleaning control device 57 executes a normal cleaning operation which requires relatively large quantity of ink (STEP M). After the normal cleaning operation, the process goes back to STEP A

[0037] On the other hand, when the residual amount of ink in any one of the ink cartridges is smaller than the sum of the preset minimum ink amount stored in the semiconductor memory device 32 of the respective ink cartridge 10, 20 and the ink amount to be consumed by the normal cleaning operation, the cleaning control device 57 executes a brief cleaning operation which requires less ink than that by the normal cleaning operation (STEPS O, R). In this operation, an ink end condition is displayed with respect to the ink cartridge which suffers the shortage of ink, so that the apparatus offers a user to replace the ink cartridge with a new one (STEPS S, P). When the ink cartridge is replaced with a new cartridge full of ink following the display indicative of the shortage of ink (STEPS Q, T), the process goes back to STEP I where the cleaning operation is resumed.

[0038] Further, in STEP T, when a new ink cartridge is mounted on the printhead, new ink is supplied to the printhead from the new ink cartridge. Because the brief cleaning operation has been performed before replacing the old ink cartridge, the clogging problem at the nozzle openings might have been fixed to some extent. Accordingly, the ink supply to the printhead from a new ink cartridge can be achieved assuredly and smoothly compared with a case in which the old ink cartridge is replaced without performing a brief cleaning operation.

[0039] In this case, because a part of the cleaning has been carried out before replacing the ink cartridge, it is preferable that the resumed normal cleaning operation should be performed at the reduced amount of ink which has been consumed in the previous cleaning operation performed with the old ink cartridge.

[0040] According to the above embodiment, the possibility of the cleaning operation is determined in accordance with the preset minimum ink amount stored in the semiconductor memory device 32 of the ink cartridges 10, 20 at the time when the ink cartridge is shipped from the factory. Accordingly, the optimum minimum ink amount can be preset corresponding to the drying speed of ink and variation of the volatile speed of the ink solvent or the like. As a result, the apparatus can be prevented from the problems that the print head is damaged by the white dot, i.e., ejection of no-ink, and an erroneous ink end indication is displayed while a large amount of ink is still remained in the ink cartridge.

[0041] In addition, in the embodiment described above, if the residual amount of ink is small, the brief cleaning operation is performed so that the ink is effectively

consumed. However, it may be applicable that the brief cleaning operation is not carried out, i.e., the STEPS O and R are omitted, and the following process is stopped while displaying the ink end indication and waiting for the replacement of the ink cartridge.

[0042] Fig. 9 shows one preferred embodiment of a cartridge reproducing device. Reproduction control device 60 reads data from the semiconductor memory device 32 of the recycled ink cartridge 10', 20' through access means 61, and controls ink discharge means 63, parts exchange means 64, cleaning means 65 and ink charge means 66 in accordance with evaluation data stored in data storage means 62, and in accordance with this evaluation data, the refill control device 60 causes the operating conditions in the printing apparatus to be stored in the semiconductor memory device 32.

[0043] The operation of the reproducing device of this construction will now be described with reference to a flow chart shown in Fig. 10.

[0044] When the ink cartridge 10' is set on a working pallet 67 (Step A), the reproducing control device 60 reads the data from the semiconductor memory device 32 through the access means 61 (Step B), and it is judged whether or not the number of reproductions of this ink cartridge is less than a predetermined number (for example, 10) (Step C), whether or not the time period after the manufacture is less than a predetermined period (for example, 10 years) (Step D), whether or not the time period after the latest ink end is less than a predetermined period (for example, 200 days) (Step E), and whether or not the ink cartridge has been used in a predetermined environment (Step F). If all of these judgments are satisfied, it is indicated that the re-use of the cartridge is possible (Step G), and the reproduction processing is effected (step H). On the other hand, if any of these requirements is not satisfied, it is indicated that the re-use of the cartridge is impossible, and there is given an instruction to discard this ink cartridge.

[0045] The cartridge, which satisfies the reproduction requirements, is transferred to the ink discharge means 63 by the pallet 67, and the ink, remaining in the cartridge, is discharged therefrom by suction or the like (Step A in Fig. 11). The reproducing control device 60 judges from the data, read from the ink cartridge whether or not the part (for example, a packing fitted in the ink supply port) reaches the limit of the lifetime (Step B in Fig. 11), and the necessary part is exchanged by the parts exchange means 64 (Step C in Fig. 11).

[0046] Then, in view of the lapse of time after the latest ink end, it is judged whether or not the cleaning is necessary (Step D in Fig. 11), and in accordance with this time period, the time of cleaning by the cleaning means 65, that is, the degree of cleaning, is determined (Steps E to G in Fig. 11)

[0047] When the pretreatments necessary for the reproduction are finished, the reproducing control device 60 judges whether or not the ink cartridge should be washed with ink to be charged (This is necessary be-

a control device accessible to said memory device for controlling said print head in accordance with data supplied from the exterior, said control device controlling a charging of the ink into said print head in accordance with data stored in said memory device, when said ink cartridge is attached to the printing apparatus.

15. An ink-jet printing apparatus according to claim 14 wherein said control device judges from the data in said memory device whether or not the attached ink cartridge is a reproduced one.
16. An ink-jet printing apparatus according to claim 14, wherein the control of the ink charging operation is directed to the amount of drawing of the ink.
17. An ink-jet printing apparatus according to claim 14, wherein said control device causes data, related to the conditions of use of said ink cartridge, to be stored in said memory device when said ink cartridge is to be detached from the printing apparatus.
18. An ink-jet printing apparatus according to claim 17, wherein said data, related to said conditions of use, is the time of ink end of said ink cartridge.
19. An ink-jet printing apparatus according to claim 17, wherein said data, related to said conditions of use, is conditions of maintenance of said print head during the time when said ink cartridge is attached to the printing apparatus.
20. An ink-jet printing apparatus according to claim 17, wherein said data, related to said conditions of use, is data related to an environment during the time when said ink cartridge is attached to the printing apparatus.
21. An ink-jet printing apparatus according to claim 14, wherein said control device judges from the data, stored in said memory device, whether or not the next reproduction is possible.
22. An ink-jet printing apparatus according to claim 14, wherein said control device judges whether or not the next reproduction is possible in accordance with the data stored in said memory device, and the control device causes to display that the ink cartridge is discarded if it judges that the reproduction is impossible.
23. A ink-jet printing apparatus according to claim 21 wherein said judgment is made in accordance with the number of reproduction, a lifetime, a time period after detection of ink end, and an environment of use

#### 24. An ink-jet printing apparatus comprising:

a print head for ejecting ink droplets;  
 an ink cartridge containing ink therein for supplying the ink to said print head;  
 a memory device storing data representative of a preset minimum ink amount and a residual ink in the ink cartridge; and  
 a control device accessible to said memory device for controlling said print head in accordance with data supplied from the exterior, said control device judging whether a cleaning operation is necessary in accordance with the data stored in said memory device.

25. An ink-jet printing apparatus according to claim 24, wherein said control device executes the cleaning operation when the residual ink amount is greater than the sum of the preset minimum amount of ink and an amount of ink which is consumed by the cleaning operation.
26. An ink-jet printing apparatus according to claim 24, wherein said control device executes a brief cleaning operation when the residual ink amount is greater than the preset minimum ink amount but less than the sum of the preset minimum ink amount and an ink amount which is consumed by the cleaning operation.
27. A cartridge reproducing device for an ink cartridge for an ink jet type printing apparatus, the reproducing device comprising:  
 means for reading data, related to a history of use of the ink cartridge to be reproduced, from memory device provided on the ink cartridge; and  
 a control device which controls reproduction processing apparatus in accordance with said data, and causes at least data, representing the number of reproduction and the time of reproduction, to be stored in said memory device after the reproducing operation is finished.
28. A reproducing device according to claim 27, wherein said control device causes data, related to conditions of maintenance of the ink cartridge, to be stored in the memory device after the reproducing operation is finished.
29. A reproducing device according to claim 27, wherein said reproduction processing apparatus includes at least cartridge cleaning device, and ink injecting device.
30. A reproducing device according to claim 27, wherein said control device judges from the data in the

FIG. 1A

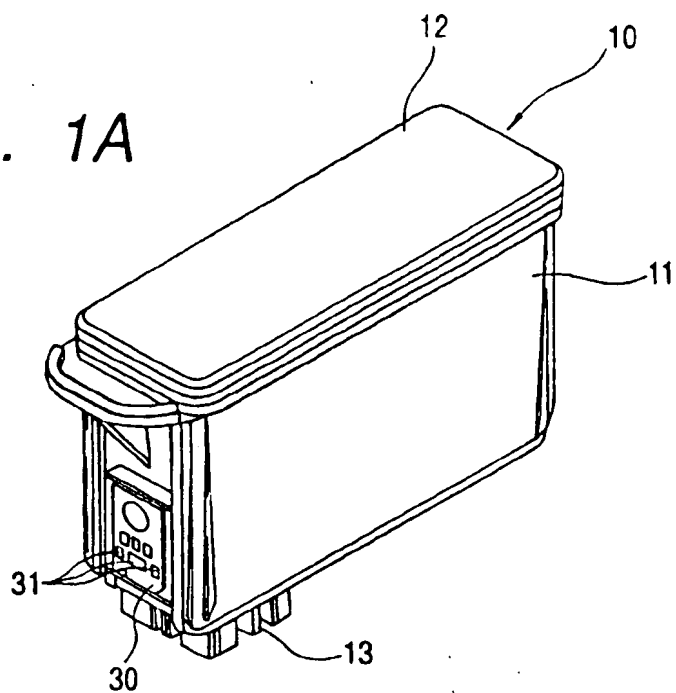


FIG. 1B

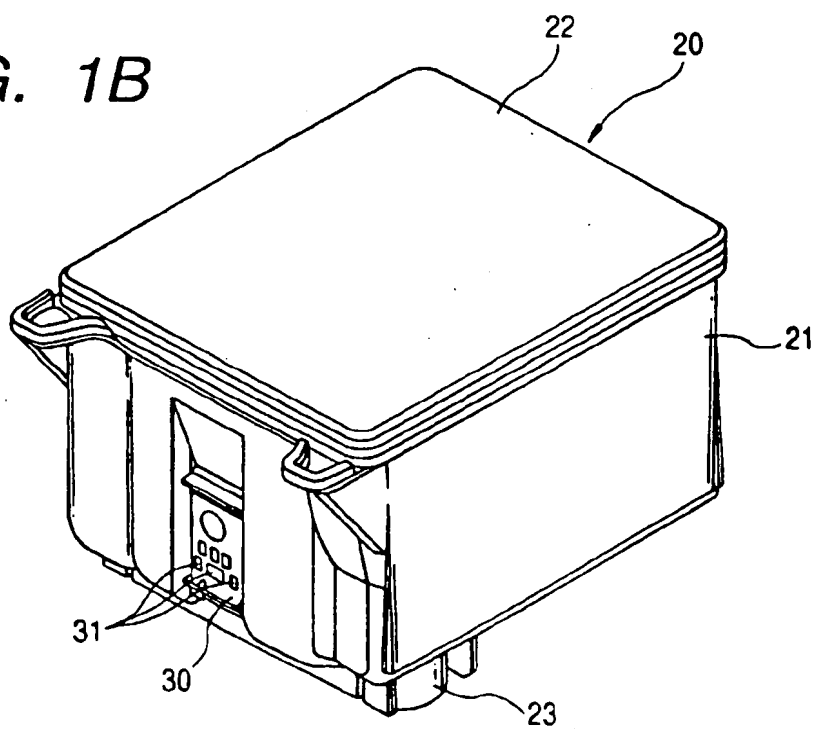


FIG. 4

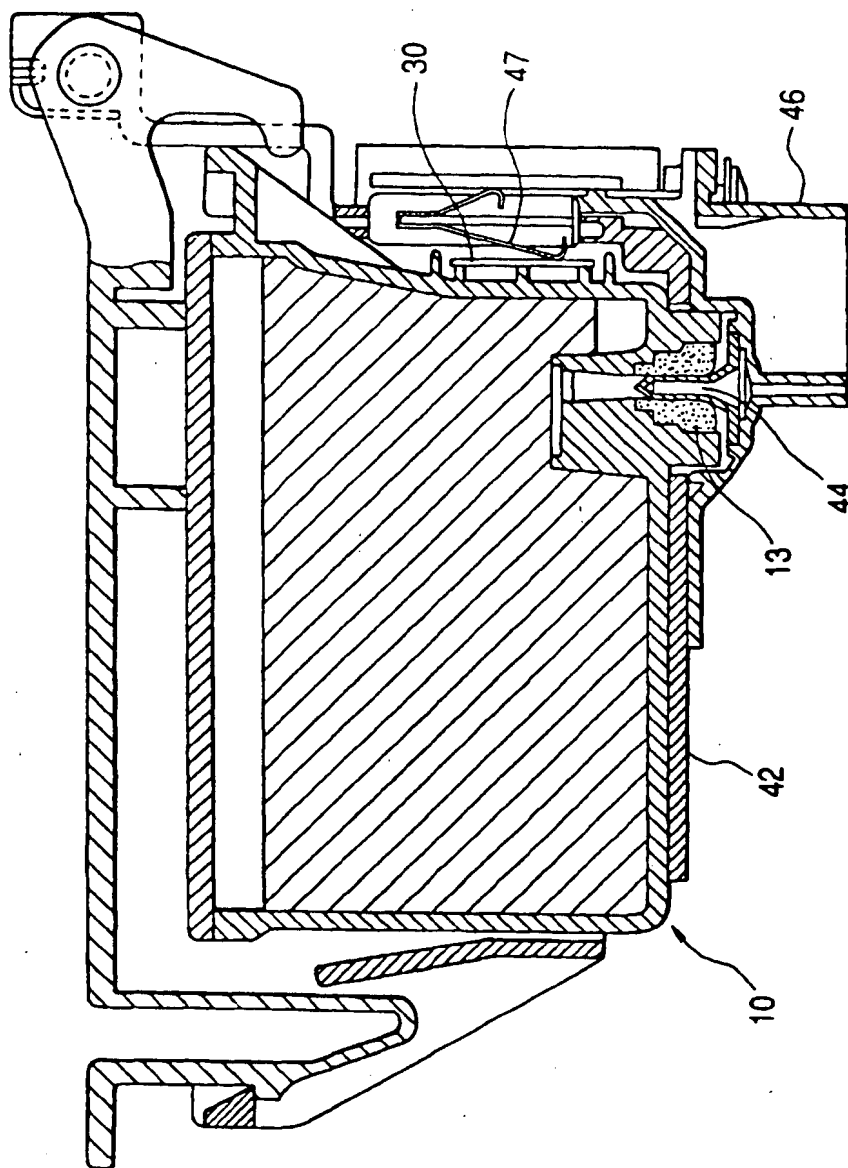


FIG. 6

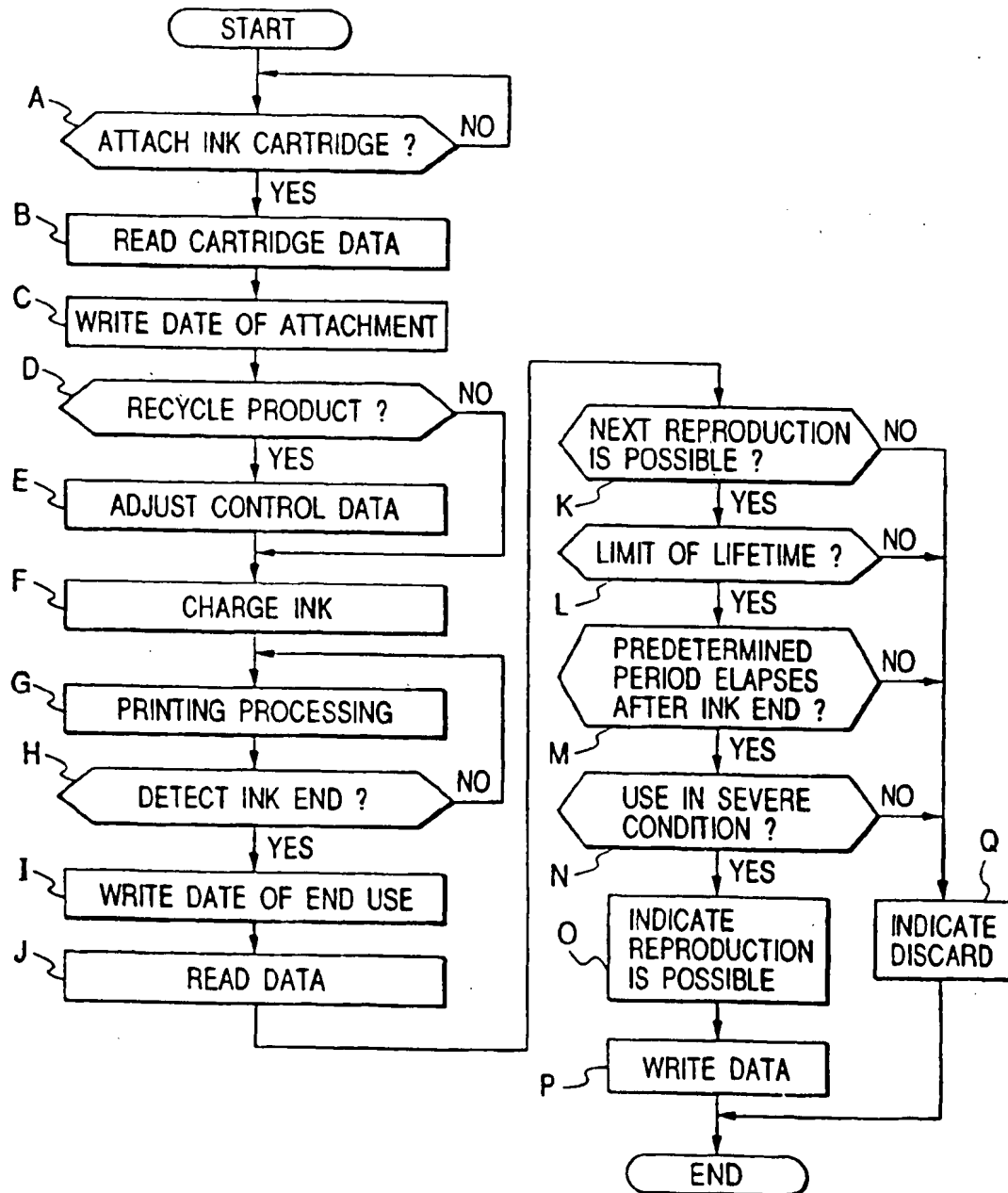


FIG. 8

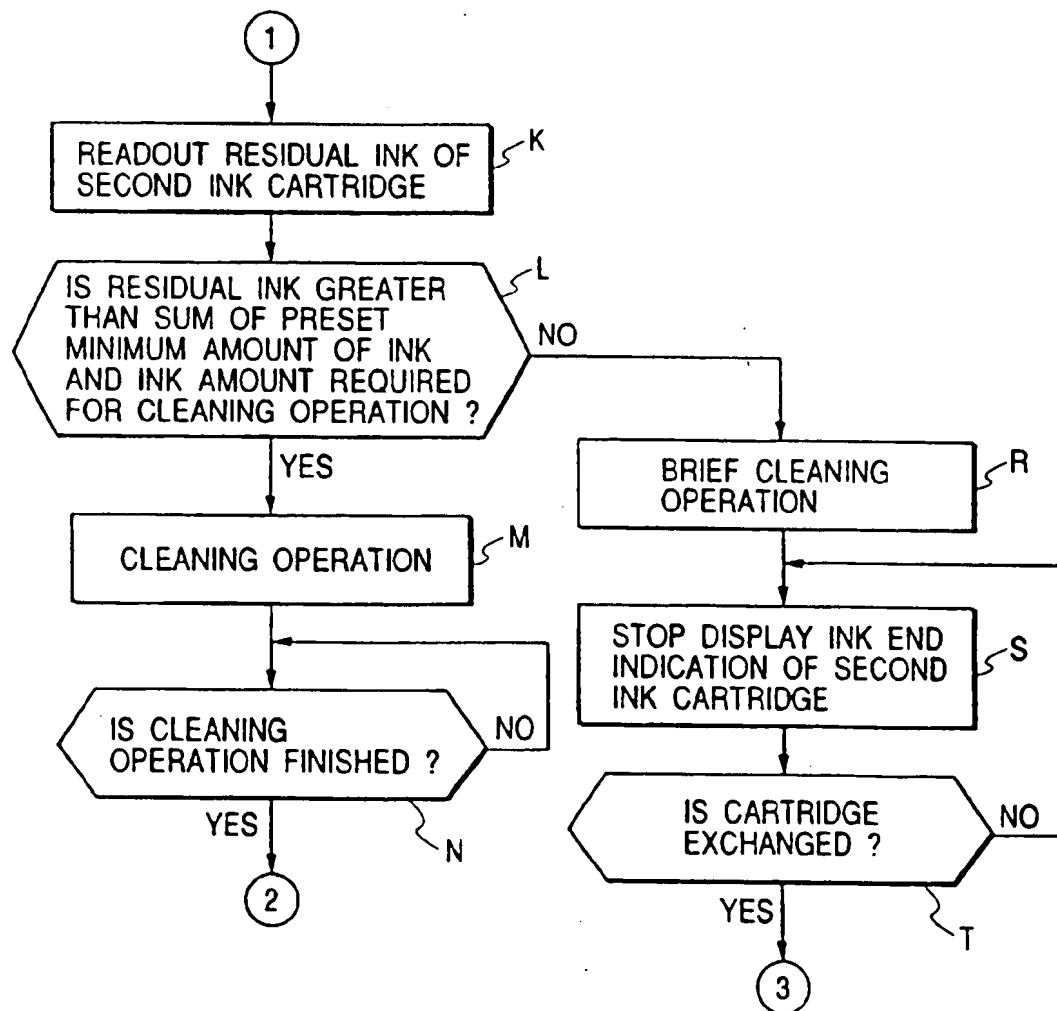
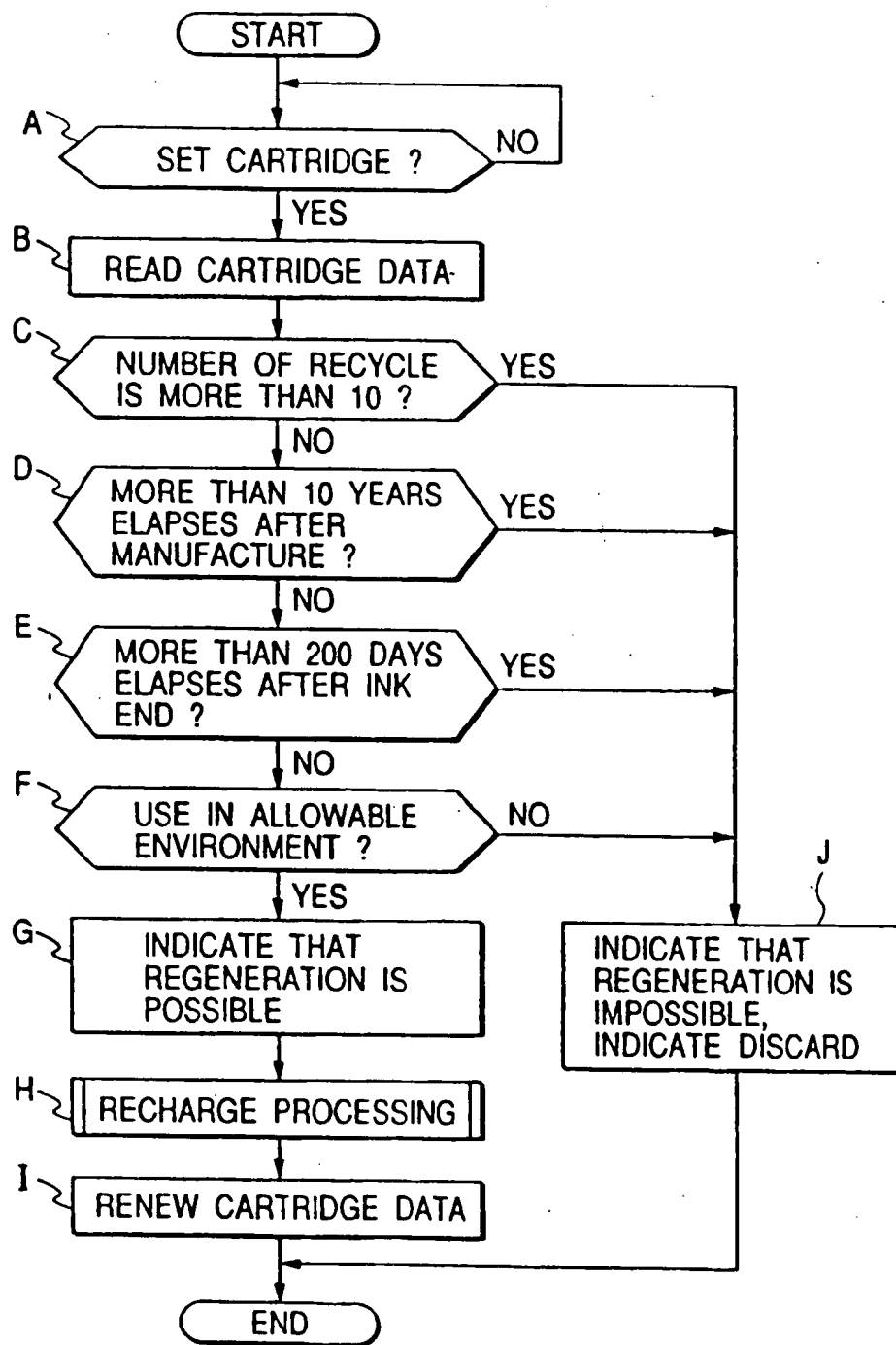




FIG. 10





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## EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 4035

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL.6)
X	EP 0 789 322 A (HEWLETT PACKARD CO) 13 August 1997 (1997-08-13) * column 8, line 14 - column 9, line 25; figures 4-7 *	1,13,14, 27,33	B41J2/175
A		2-12, 15-26, 28-32, 34,35	
X	EP 0 778 140 A (SEIKO EPSON CORP) 11 June 1997 (1997-06-11) * column 12, line 19 - line 53; figure 13 * * column 19, line 24 - column 20, line 14 *	1	
A		13,14, 27,33	
A	WO 98 04414 A (PHILIPS ELECTRONICS NV ;PHILIPS NORDEN AB (SE)) 5 February 1998 (1998-02-05)	1,13,14, 27,33	
A	WO 90 00974 A (SIEMENS AG) 8 February 1990 (1990-02-08)		
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>1 September 1999</b>	Examiner <b>Adam, E</b>
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